normal dispersion of the solvent; and even if no ray can then acquire an index of refraction less than unity, or be completely isolated from the rest, the succession of colours in the dispersion-spectrum of the solution will be sensibly different from that which is commonly observed.

The method employed by Kundt for the observation of abnormal dispersion in solutions of bodies with surface-colours (suggested by a memoir published by Christiansen of Copenhagen), is as follows:—A drop of the concentrated solution to be examined is placed on a glass plate, and over this drop is fixed, at an angle of about 25°, a sharp edge of a second glass plate of the same breadth as the first. At a small distance from the line of contact of the two plates, the liquid prism formed by capillary action is usually opaque; but close to the line of contact there is a prismatic layer of liquid, scarcely broader than a hair, which is transparent for most of the colours. The dispersion may be recognised by viewing through this layer a narrow and bright flame or an illuminated slit. The observations of course require a certain amount of practice, and the observer must be on his guard against deception arising from phenomena of reflection or refraction. The observation is generally made by carrying the liquid prism to the place of the glass prism in the spectroscope of Bunsen and Kirchhoff, the most favourable angle to give to the liquid prism being determined by trial.

Christiansen has observed that the index of refraction of a strong alcoholic solution of fuchsine increases from the line B to D, then diminishes rapidly as far as G, and increases again beyond that line; and the recent observations of Kundt, made as above described, have demonstrated the generality of this anomalous dispersion for surface-coloured bodies in the state of solution; that is to say, that in the dispersion-spectra of these solutions the order of the colours is not the same as in the solar spectrum, or in the dispersion-spectra of ordinary solutions. Such was found to be the case, not only with fuchsine, but with all specimens of aniline-blue and aniline-violet, with aniline-green (Hofmann's iodine green), indigo (dissolved in fuming sulphuric acid), indigo-carmine, carthamin, murexid (dissolved in potash), cyanine, potassium-permanganate, and carmine.

All the bodies in this list refract red more strongly than violet light; and in bodies for which the green forms the principal part of the surface-colour, and can be distinctly recognised in the transmitted spectrum, the green rays are the least deviated. Cyanine, aniline-violet, and aniline-blue, as well as indigo-carmine, give, therefore, in their dispersion-spectra the following series of colours: green, blue, red, the green being the least deviated. Cyanine is particularly well adapted for producing the abnormal spectrum, and exhibits the following series of colours: green, light blue, dark blue, a dark interval, red, and traces of orange. The dispersion varies however with the concentration of the solution; in dilute solutions all the bodies above enumerated exhibit normal dispersion. Potassium-permanganate and carmine exhibit reversed spectra only when their highly concentrated solutions are mixed with fine solid particles so as to form a sort of pulp, and the two glass plates are pressed strongly together. A change in the dispersion is also observed according to the angle of incidence.

Soret pours the solution under examination into a hollow prism having an angle of about 30°, and places this prism in a glass trough with parallel sides, filled with the liquid which serves as solvent. By this arrangement the reverse spectrum may be obtained with solutions less concentrated and therefore more transparent than when the liquid prism is merely surrounded by air.

If the ordinary prism of a spectroscope be replaced by a hollow prism filled with a concentrated solution of fuchsine, the reversed spectrum will be seen without the aid of the trough above described, provided the light is very strong and passes very close to the edge of the prism. With a less concentrated solution the spectrum is normal, and with a solution of intermediate concentration the spectrum is reduced to a single red line. In this case the anomalous dispersion due to the fuchsine is entirely compensated by the normal dispersion produced by the alcohol, and the result is deviation without dispersion. If now the prism containing this last-mentioned solution be immersed in a trough containing alcohol, the deviation of the rays produced by the alcohol will be almost wholly destroyed, while the abnormal dispersion of the fuchsine will remain, the red being more strongly deviated than the violet. With this arrangement it is no longer necessary to employ so strong a light, or to make the rays pass so close to the edge of the prism.

With the prism in air the deviation of the red rays is about 11° 30′; but when the prism is immersed in alcohol, the violet is scarcely deviated, the red by fifteen minutes, and the orange by twenty-three minutes.

Similar results were obtained with aqueous solutions of aniline violet and potassium-permanganate.

MR. BENTHAM'S ANNIVERSARY ADDRESS TO THE LINNEAN SOCIETY[*]

(*Concluded from p.* 114.)

TO Grisebach's notes on the connections of the tropical African flora with that of other countries I shall have but few observations to add. The intergrafting with the South African flora along the eastern side of the Continent may well be attributed to climate and other present physical conditions. The European character of the higher mountain vegetation of Abyssinia and the Cameroons may be indicative of the remains of that western flora, the mysteries of whose distribution north and south of the tropics I have on several occasions alluded to. The supposed evidences derived from the vegetable kingdom of a once existing connection between west tropical Africa and east tropical America through an ancient Atlantis gradually disappear on further investigation. No traces of a western Atlantic or American vegetation were met with by Mann in the mountains of Fernando Po and the Cameroons, nor by Dr. Hooker in the western Atlas of Morocco. The tropical American races found in Western Africa are chiefly confined to the coast region; they are more generally identical than representative species, and they may have been brought over in the course of ages by some of those means of transport which even now may occasionally occur, such as the Gulf Stream, as mentioned by Grisebach. You may recollect, for instance, a short notice by Dr. Dickie inserted in our Journal (Botany, vol. xi. p. 456) of a green floating mass, twelve to fourteen miles broad, crossed by Captain Mitchell in the Atlantic, within 300 miles of the mouth of the Gambia, which had evidently, as Dr. Dickie believes, come from some part of America within the influence of the Gulf Stream, probably passing between the Cape Verde Islands and the mainland of Africa. Besides algæ, the portions of this mass picked up by Captain Mitchell and examined by Dr. Dickie contained, amongst other substances, fruits, seeds and "seedling plants several inches long, all with a pair of cotyledons, roots, and terminal bud, quite fresh."[†] With regard to those American genera represented chiefly in eastern tropical Africa, to which I called your atttention in my paper on Compositæ, there are various considerations, requiring too much detail for me now to enter upon them, tending to show a greater probability of an ancient interchange having taken place far south of the tropics, or eastward over lands long since submerged, than across the tropical Atlantic. A prevailing eastern element in the tropical African flora has, indeed, been frequently pointed out. An interchange with continental India is so well marked north of the equator as to have been generally admitted; but south there are many distinct types represented only in Madagascar, Ceylon, Malacca, the Archipelago, or Australia. This would lead one into speculations put forward also by naturalists in other branches as to a vast continent once bridging over the Indian Ocean, and extending even far to the eastward into the Southern Pacific. Similar views derived from zoology have been recently put forward by Grandidier in a most interesting sketch of the physical geography and natural history of Madagascar, contained in No. 46 (May 11) of this year's *Revue Scientifique*. This island, whose evident antiquity and long isolation, aided by its broken surface, has enabled it to become the seat or centre of preservation of a very large number of endemic monotypes, shows also in its vegetation, besides African, many Archipelago and even Australian types. Grandidier believes that in zoology the more distant eastern connection is at least as evident, if not more so, than that with the almost adjacent African continent. In plants the African connection is decidedly predominant.

I shall not attempt to follow Grisebach in discussing the peculiarities of the remainder of his regions. We may observe throughout the same careful investigation of the climatic conditions and their influence on their vegetative character of the individual plants, and on the general aspect of the whole vegetation they constitute (*Vegetationsformen* and *Vegetationsformationen*), with the same high estimate, or we might say over-estimate, of its effects on the typical character of the species as compared with the complicated consequences of previous possession, foreign invasions, and natural selection in the struggle for life, which he seems disposed to ignore, and with the same allusions to certain mysterious creative or productive forces beyond the reach of our inquiries. A closer examination of his regions show them to be much better conceived in his phyto-climatic point of view, than I had at first thought them to be when regarded as phyto-geographical regions; and although further explorations may cause him to modify their limits in several instances, yet, in regard to all of them, the data he has collected and methodised will be found to be an important contribution to the scientific study of geographical distribution, the value of which is enhanced by copious references to the sources whence he has derived his information.

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[*] Delivered Friday, May 24, and abridged.

[†] It may require, however, as suggested by Dr. Hooker, some further evidence to show that this green mass might not as well have been brought down from some African as from some American river.

There are two general subjects upon which the bulky mass of literature continues to receive considerable accessions, both in this country and on the Continent, without perhaps adding much to our stock of information, and which would at any rate require long and patient study to extract what may be really of value; these are Darwinism and so-called Spontaneous Generation. Darwinism in some shape or other, or something under that name, enters more or less into almost all general discussions on points of natural history, especially on the Continent, and in so far as it is applicable to what the Germans call the *Descendenztheorie*, it is being more or less tacitly adopted by the great majority of naturalists; but in a general way, the comprehensive hypotheses propounded by Darwin in his various works are still the subject of much polemical discussion. Seidlitz, in his work entitled "Die Darwinsche Theorie," fills thirty pages with the mere titles of the works, memoirs, or papers published on the subject since 1859, and to this enumeration many additions might be made. Amidst this great mass it might have been expected that I should have selected some to bring specially under your notice—that I should have followed up the observations I made on the "Origin of Species" in my address of 1863, and on the "Variation of Animals and Plants under Domesticity" in that of 1868, by some notice of the "Descent of Man," as well as of some recent works of other writers, such as Mivart's "Genesis of Species;" but these have been already fully discussed by naturalists much more competent than a purely systematic botanist to deal with the question in the phase which it has now reached, and I have not met with any other work in which any connected series of observations has been methodised and brought to bear more directly on the general life-history of animals and plants. The detached observations upon several points connected with Darwin's general theories, especially those relating to dichogamy and cross-fertilisation in plants, continue to be very numerous, as well as the endeavours to connect recent with geologically ancient races of both animals and plants, without, however, making any one move of importance towards the solution of the problems before us; and we are still anxiously awaiting from Mr. Darwin himself that long-promised second portion of his great digest which is to treat of the variations of undomesticated animals and plants.

Spontaneous Generation has perhaps been of late the subject of more controversy in this country than abroad. Since Prof. Huxley, followed by Prof. Tyndall, placed the matter in so clear a light at the Liverpool meeting of 1870, Dr. Bastian has returned to the charge. In his work entitled "The Modes of Origin of Lowest Organisms," he has published an account of numerous experiments further illustrating his views in opposition to those of Huxley and Tyndall, and confirming, in his mind, the theory of Archebiosis, the name he gives to what is commonly called Spontaneous Generation. On the other hand, Mr. N. Hartley has communicated to the Royal Society ("Proceedings," xx. No. 132) his experiments concerning the evolution of life from lifeless matter, which appear to have been conducted with great care, and in some measure under the guidance of Dr. Odling and Prof. Tyndall. From these he concludes that so far as our present knowledge guides us, whether we term it Spontaneous Generation, Abiogenesis, or Archebiosis, the process by which living things spring from lifeless matter must be said to be only ideal. The same number of these "Proceedings" contains abstracts of papers by Dr. Crace Calvert on the development of protoplasmic life, its influence on putrefaction, and the effect of various substances in promoting or arresting its progress, all of which papers are connected with, and in continuation of, his former experiments and conclusions tending to support the theory that this protoplasmic life is derived from invisible germs floating in the atmosphere. Dr. Bastian, at a later meeting of the Royal Society, again returned to the subject in a paper entitled "On some Heterogenetic Modes of Origin of Flagellated Monads, Fungus-germs, and Ciliated Infusoria," inserted at length in No. 133 of the "Proceedings." The experiments and observations here detailed are very interesting as to the development of these organisms in the pellicle that forms on infusions of organic matter when exposed to the atmosphere; but they do not affect the question of the origin of the living components of the pellicle itself, which he considers to have been fully proved by his own former papers, as well as by the well-known experiments of Pouchet and others, to have been evolved from lifeless matter by archebiosis. A more extended work, giving the fullest details of his views of the "Beginnings of Life" is announced, but I have not yet seen it.

If, then, Spontaneous Generation may as a theory in the minds of some persons have become referred to the class of paradoxes like the quadrature of the circle, yet it is still supported by so many naturalists whose opinions are entitled to consideration, and there is so much to be said for as well as against it which appears unsusceptible of direct and positive proof, that it is likely to be long maintained as a subject of controversy, without any further much more definite result. But there is one question of a more practical nature, often supposed to be connected with it, which has excited, and is still calling for the serious attention of men of science, experience, and judgment, as well as of various Governments. I allude to those parasitical scourges which within the last thirty years have made such havoc in several important articles of European food and industry. Thirty years since, and I believe up to the fatal year 1845, the potato-disease, the silkworm-pébrine, and the oïdium of the vine were unknown in Europe; and we can most of us remember how the sudden appearance and rapid extension of each in succession produced the famine in Ireland, and the ruin of so many French and Italian silk-breeders and wine-growers of the Mediterranean region, Madeira, and Bordeaux; and how for long men of science have been baffled in their efforts at ascertaining the true history of the attendant fungi, and devising an efficacious remedy. The potato-disease appears now to have settled down into one of those chronic epidemics whose varying intensity, according to season and other circumstances over which we have little control, must enter into the calculations of every potato-grower. This useful tuber can no longer, indeed, be advantageously cultivated in that wholesale manner which induced the late Thomas Andrew Knight and others to attach to it so high an economic value, but it may now again be fairly depended upon as an important article of household food.

The pébrine of the silkworm, from the latest reports I have seen of the Commissions of Lyons and other places, shows but little abatement of its intensity, although it it has in some measure changed its character, and is, it is to be feared, through the carelessness or cupidity of interested dealers, spreading even into those eastern regions which have been looked to for the supply of "seed" free from the fatal germ. The oïdium, on the contrary, has been got more under control; and experience now shows that in many districts at least its ravages can be checked or entirely stopped by means within the reach of every intelligent cultivator. But within the last few years a new plague has in the south of France excited even more alarm than the oïdium itself, from its insidious invasion and complete destruction of many of the most valuable vineyards; this time, however, the offending parasite is brought much more within the scope of direct scientific observation. The germs of the potato-fungus, of the pébrine, of the oïdium, are all invisible and inappreciable by any of our instruments; the history of their diffusion and early development, and even their very existence, can only be judged of from their results and other circumstantial evidence; whilst the *Phylloxera vastatrix* can be watched in every stage of its varied existence, from the first deposit of the fertilised eggs, through its several agamic generations, to the latest winged form. The researches, accordingly, which have been already applied to it have not been altogether barren of results, throwing some light even generally upon the origin and dispersion of these pests. Considerable sums of money, either from the French Government or from private subscriptions, have been applied to the purpose, and the investigation has been chiefly carried on by our foreign member, Dr. J. E. Planchon, of Montpellier, assisted by

M. J. Lichtenstein, a relative, I believe, of the late distinguished Prussian zoologist. These gentlemen, since the first discovery of the disease in France in 1868, have devoted much of their time to it. They have compared their observations with those of others who in other countries have studied the insect, especially Mons. Laliman, of Bordeaux, Mr. Riley, of Missouri, and with those of Prof. Westwood in our own country; and they have now, in a pamphlet which, by some inversion of dates not uncommon abroad, is supposed to form part of the Proceedings of the session of the French scientific congress at Montpellier in 1868, given a *résumé* of nearly five hundred memoirs, communications, or journal articles which have been published on the subject up to the close of last year (1871).

The main facts given as having been hitherto elicited as proved or probable may be shortly resumed as follows:—

The *Phylloxera*, like other Aphides, goes through a number of apterous generations of a single sex, but multiplying with enormous rapidity; for one or two individuals will lay as many as five hundred eggs, fertilised without previous copulation. It also gives birth occasionally to a winged generation of both sexes, the females of which lay only two or three eggs each.

The apterous *Phylloxera* is also dimorphous, a smooth-bodied form living in little galls formed on the leaves of the vine, where it is comparatively harmless; and a tuberculate form living in the nodules it produces on the root-fibres, causing first the smaller and then the main roots to rot, weakening, in the first instance, and finally killing the whole vine. Each form has its winged ganeration.

The insect is evidently of North American origin, although the precise history of its transmission to this country has not been ascertained. It was first described by Asa Fitch in the Transactions of the New York State Agricultural Society for 1854; but living there chiefly on the leaves of the native vines, it had not attracted any peculiar attention. More recently, however, Mr. Riley has found reason to attribute to the ravages of the subterranean form the ill success of the various attempts made to establish in America the European grape-vine. In England, where the introduction of the insect from America may be readily conceived, Prof. Westwood's attention was first called to it in 1863, and again from various quarters in 1867 and 1868, whence resulted the above-mentioned account in the *Gardener's Chronicle* for January 1869 (p. 109). With us it does not appear to have spread much, and has therefore not called for any further observation, the damp soil, the mode of treatment, or other external circumstances, proving unfavourable for the development of the underground form. But having by some means reached and established itself in the dry, naturally-drained vineyards of the south of France its general character underwent a change; natural selection at once gave an enormous preponderance to the underground over the epiphyllous form. It was first discovered there in July 1868, and by the close of that year its ravages caused a panic among the vine-growers in many parts of Lower Languedoc and Provence, similar to that which we may remember in this country on the rapid spread of the potato disease in the autumn of 1845. It was immediately made the subject of scientific investigation, which has ever since been steadily pursued. As one result Dr. Planchon inclines to believe that the oïdium and the potato disease, like the *Phylloxera*, and, in former days, the American blight of our apple-trees, had all been imported from America. It would seem that all these parasites, whether insects or fungi, capable of enormously rapid and extensive propagation, remain unnoticed so long as they are kept in check by the mutual relations of their constitution, habits, food, and other circumstances in which they are placed; but that the moment that a change, often very slight, in one or other of these conditions destroys the balance, they may at once and suddenly gain the upper hand, so as to be classed in the popular mind amongst those varied phenomena collectively designed as blights. That such a change is often the consequence of the transportation of the insect from one country to another may be regarded as more probable if Riley is correct in his belief that in America, as in Europe, introduced insects, when once established, are more noxious than indigenous ones. In the case of the *Phylloxera* some clue to the nature of the influencing alteration may be derived from the success attending one of the remedies applied, the inundation and continued submersion of the diseased vineyards during the winter months. The comparative dryness of the soil in the new over that of the original station of the insect has been the change which natural selection seems to have seized upon to effect the extraordinary development of the underground form, aided, perhaps, by some slight attendant change in its constitution. Prolonged, or even temporary inundation, is not however, practicable in the majority of the South of France vineyards, nor, indeed, in any of those producing the best wines. Amongst other remedies, soot (the soot of wood-smoke I presume) promises to be one of the most efficacious applications.

Amongst the various publications which these phenomena have called forth, we may still see cropping up not unfrequently the popular notion that they are blights mysteriously connected with meteorological conditions, against which it is vain to struggle; but, fortunately, the need of separately investigating every one of them is becoming generally recognised. In France, Government has appointed special commissions for inquiries into the silk and wine diseases. In Germany the ravages committed by insects on their forests have been the subject of various works, published chiefly under the patronage of the Austrian Government and scientific associations. In North America Mr. Riley, as Missouri State entomologist, makes annual reports on noxious insects to the Board of Agriculture of that State, pursuant to an appropriation for this purpose from the Legislature.* In Italy a special institution has been formed at Padua, under official patronage, for the study of cryptogamic parasites; and our Royal Horticultural Society is also making arrangements for the special encouragement of the study of economic entomology. To these and similar institutions it is the duty of science, in the interest of mankind, to give its unqualified support, to divest itself of all preconceived theories and prejudices, to avoid those polemical discussions which appear to have gone beyond the security they give for the exhibition of facts in all the various points of view they may bear, but impartially to study every detail connected with these scourges, which have so much increased during the present century, fostered, perhaps, by the advance of civilisation and high cultivation.

SCIENTIFIC SERIALS

THE *Lens* (No. 2), April, 1872.—This second number of the new American journal of microscopy contains little that is new or of importance. "The Flora of Chicago and its Vicinity" is continued by H. H. Babcock from the previous number, as is also the "Conspectus of the Families and Genera of the Diatomaceæ," by Prof. H. L. Smith. This second part of the Conspectus is occupied by a "Synonym Register," which promises to be useful, and is in fact the most complete attempt of the kind yet made. "Microscopical Memoranda for the use of Practitioners of Medicine," by Dr. J. J. Woodward, is also a continuation, and consists of two parts, viz., staining the sections, and mounting the stained sections in Canada balsam. There is also a chapter "On the double marking of *Triceratium*," by the same author, accompanied by a Woodbury print of two frustules of *Triceratium fimbriatum*. "On the effect of the reversal of the current of the Chicago River on the Hydrant Water," by H. H. Babcock. "Where to search for Diatomaceæ" is a reprint from the *Intellectual Observer*, and "Alternation of generation in Fungi," by M. C. Cooke, from NATURE. This number of the *Lens* is increased to double the thickness of the previous one by the insertion of the catalogue of optical instruments manufactured or sold by an American firm in Philadelphia and New York.

IN the *American Naturalist* for April we have an article by Dr. J. J. Woodward on the Use of *Amphipleura pellucida* as a Test-object for High Powers, illustrated by a photograph. Dr. Abbott concludes his exhaustive paper on the Stone Age of New Jersey; and the remainder of the number consists of reviews and book notices, and of short paragraphs under the headings of the various departments of natural science.

In the number for May is a note by Mr. J. G. Henderson on the use of the rattles of the rattlesnake, in which he comes to a somewhat different conclusion from Prof. Shaler, believing that it is protective in its object.—Mr. J. A. Allen contributes some ornithological notes from the West, the present communication referring to the birds of Kansas.—Prof. A. H. Tuttle gives the result of a careful study of the genus *Urella* of Flagellate Infusoria, illustrated with a number of woodcuts.

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* Since writing the above I have seen a proof-sheet of a portion of the forthcoming fourth report of the Missouri State entomologist, Mr. Riley, in which he enters into further details of the history of the *Phylloxera*, collected during a recent visit to Europe, as well as from closer observations on the subject made in America, where it appears to be acquiring more serious importance. I have not, however, yet seen enough of the report to learn what further conclusions Mr. Riley may have arrived at.